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IMPACT OF BUTANOL ON PERFORMANCE AND EMISSION CHARACTERISTICS OF A DIESEL ENGINE

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ABSTRACT

The draw on alcohols in diesel engines is a way of reducing dependence on diesel. Particularly, high alcohols like n-butanol (nB) consist of carbons. These alcohols can be produced from easily available sources. When they are mixed with diesel, the mixed fuel exhibited enhanced properties and thereby engine gave better performance and less emission. Various works are going on to analyze the characteristics of engine which uses alcohol. The present work examines the possibilities of using alcohol in diesel engine. In this experimental work, butanol is blended with diesel in varying Proportions and its experimentally tested in CI engine. Experimental result were compared with that of diesel.

KEYWORDS: n- Butanol (nB), Non-Edible & Compression Ignition

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Original Article

INTRODUCTION

The non-renewable energy sources are depleting at higher manner. Fossil fuel supplements a major part of our fuel demand. Alcohols are generally preferred as they can be manufactured easily as well as they are compatible with all engines. Butanol have better anti knocking capacity owing due to high octane rating. Recirculation of exhaust gases were analyzed in alcohol/diesel blend fueled engine. It was learnt that there was an augment in thermal efficiency [1]. Butanol was blended to diesel up to a maximum limit of 25%. It was learnt that there was a drop in emission with inclusion of butanol [2]. Inclusion of alcohols to other fuel like diesel would augment performance characteristics but affects physical as well as chemical properties [3]. Bio fuel was blended with diesel in many proportions and was tested in a diesel engine [4]. Alcohols blended with main diesel fuel resulted in the hike in density [5]. Augment in alcohol led to hike in mean effective pressure and thermal efficiency. But after some time, there was a drop in the same [6]. Time span of combustion declined with inclusion in alcohol content which resulted in drop in emissions [7]. The properties of fuel samples with water were compared with normal diesel [8]. Pentanol was mixed with pilot diesel in many proportions. It was seen that there was drop in temperature of exhaust gas up to certain extent and then it further raised [9]. Propanol inclusion with diesel resulted in drop of carbon monoxide emission at higher load [10]. Increment of butanol with diesel improved certain physical properties but affected calorific value [11]. Blend of butanol with main diesel influenced air fuel ratio and it promoted lean combustion [12]. Behavior of combustion with respect to fuel droplets were analyzed [13]. Butanol blended diesel

resulted in slight decrement of torque and power output from the engine [14]. There was a decrement in emission of soot particle with inclusion of alcohols [15], [16]. The addition of alcohol with main diesel fuel reduces smoke considerably owing to enhanced properties [17]. The effect of nano additives on features of a CI engine has been discussed [18, 19]. A technical review has been made on treated vegetable oil in detail [20]. Back pressure effects of exhaust on a diesel engine has been experimentally studied [21]

EXPERIMENTAL WORK

Magnetic stirrer shown in figure 1 is used to mix butanol with main diesel fuel by stirring it. Magnetic field is being employed for this purpose. The specifications of stirrer are given in table 1.

Figure 1: REMI Hot Plate Magnetic Stirrer.

Table 1: Specification of Stirrer

Model	1 MLH
Stirring Capacity (Litres)	1
Heating Capacity (watts)	150
External Dimensions (W*D*H) mm	200*225*185
Stirring Paddle (Model) (PTFE Coated)	Q-19
Stirring Paddle (Length) (PTFE Coated)	9*25mm

Table 2: Composition of Fuel Samples

Fuel Sample	Sample Composition
Sample 1	Diesel 100% (500ml)
Sample 2	Diesel 80% (400ml) + butanol 20% (100ml)
Sample 3	Diesel 70% (350ml) + butanol 30% (150ml)

The composition of fuels are shown in table 2. The above fuel samples along with diesel were tested for emissions by fitting an additional pipe from the exhaust of the engine. The details of the tested engine are given in table 3. The engine is tested with these samples of fuel under different conditions of load ranging from not any load to extreme load.

Figure 2: Single Cylinder 4 Stroke CI Engine with Mechanical Load (Belt Drum).

Table 3: Engine Specification

Engine	**Single Cylinder 4 Stroke CI Engine – Constant Speed (Belt Drum)**
Engine Make	KIRLOSKAR
Power (BP)	3.7kW (5 BHP)
Speed(N)	1500 rpm
Bore (B)	80 mm
Stroke (SL)	110 mm
Cooling Type	Water Cooled
Fuel	Diesel
Circumference of Break Drum (Cb)	0.785 m
Coefficient of Discharge	0.65
Lubrication	Splash

Figure 4: Engine Testing Setup.

The emissions from the engine has been tested with exhaust gas analyser which is shown in figure 4. A "AVL" Type Digas 444N, Emission analyzer was used to analyze the exhaust gases, the analyzer can amount the concentration of pollutants in exhaust. The Emission analyzer and its specification.

Figure 5: AVL, Exhaust Gas Analyzer.

RESULTS AND DISCUSSIONS

Performance Graph

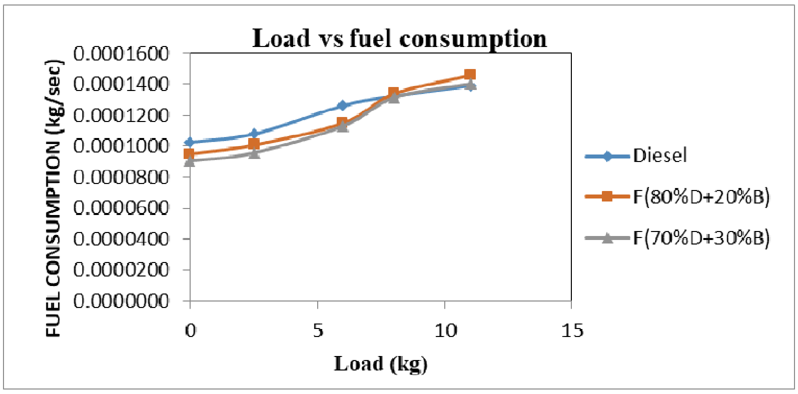

Figure 6: Load Vs Fuel Consumption Graph.

The Performance of the fuel comes with its first factor fuel consumption shown in above figure 6, and with the described samples, the diesel has very fuel consumption than all other samples made out. This is because of less calorific value of the prepared fuel then diesel.

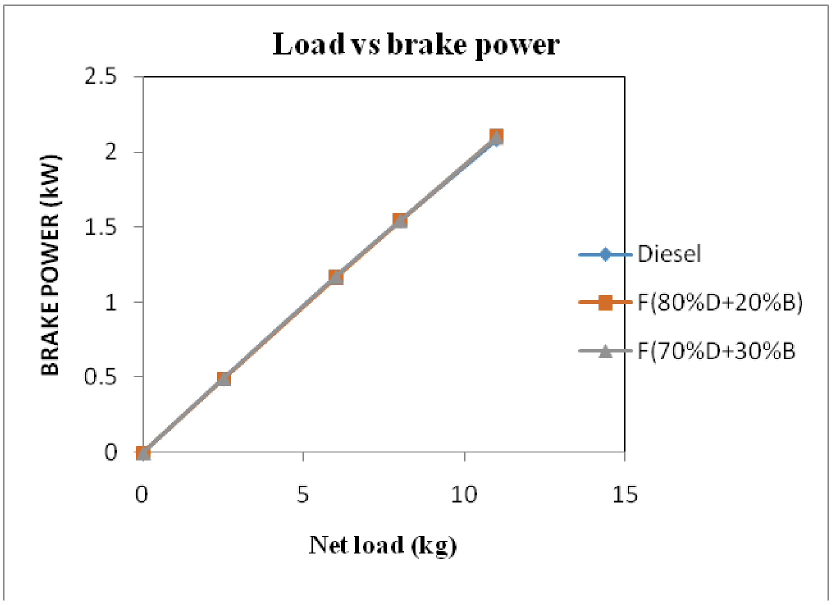

Figure 7: Load Vs Brake Power Graph.

The analysis in figure 7 showed that the brake output power of engine by diesel and fuel sample has remained

same. The sample made does not affect the brake output power of the engine.

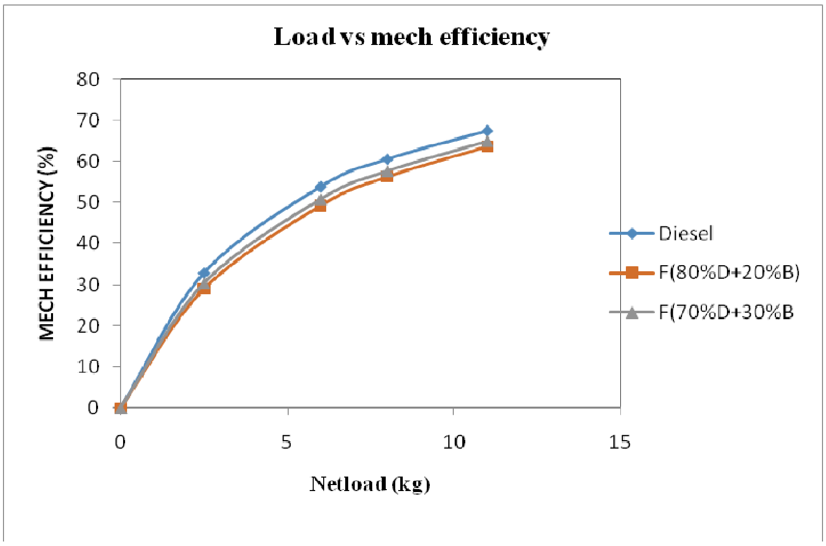

Figure 8: Load Vs Mechanical Efficiency Graph.

The mechanical efficiency of the engine with emulsion is good and the samples made are high mechanical efficient than diesel. The sample 1 has very less mechanical efficiency.

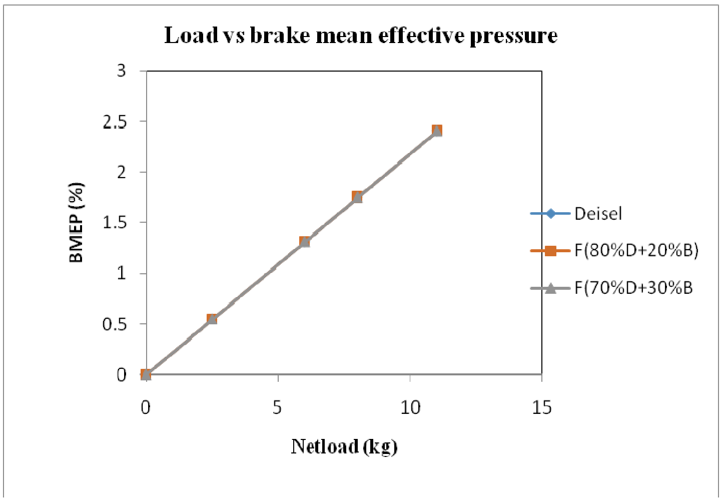

Figure 9: Load Vs BMEP Graph.

The BMEP of the engine also remained same and negotiable given in above figure 9. The sample made doesn't disturb the brake power of the engine when matched by diesel.

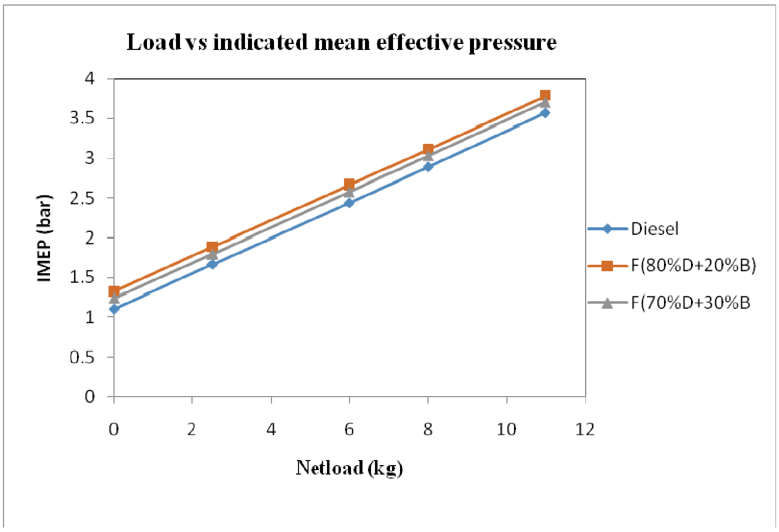

Figure 10: Load Vs IMEP Graph.

The IMEP of samples are higher efficient than the diesel as shown in figure 10. Among these, sample 1 shows its greatest potential in achievement, and rest all samples remained a layer lower down**.**

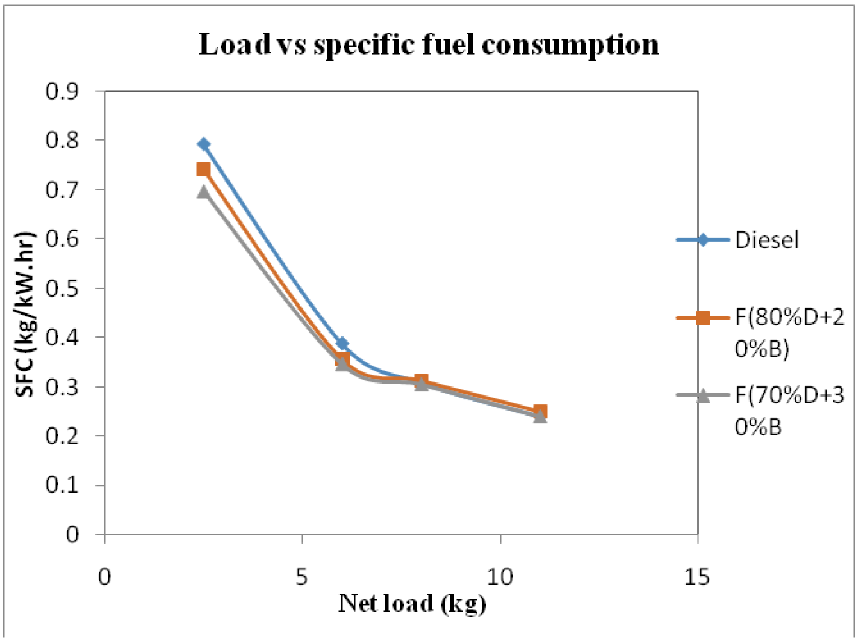

Figure 11: Load Vs SFC Graph.

Unit intake of fuel is increased mostly at sample 2. The rest are noted with the gradual increase above diesel. The viscosity and density increase of emulsion fuel samples are shows the result in figure.11.

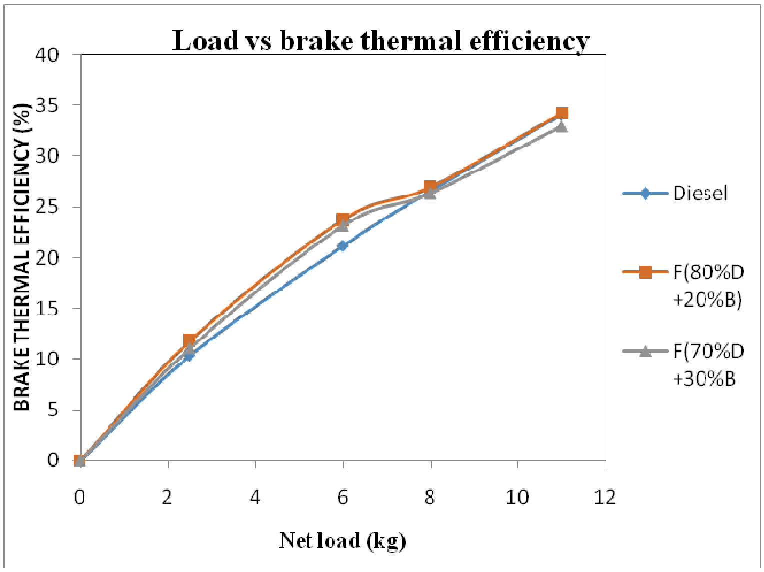

Figure 12: Load Vs Thermal Efficiency Graph.

The thermal proficiency of samples two (2) with respect to brake power is less than diesel. Rest of the samples has better thermal proficiency, due to the frictional power increase shown in above figure 12.

EMISSION GRAPH

All the graphs are plotted accordingly compared with various samples emissions and are portrayed as various emission graphs below.

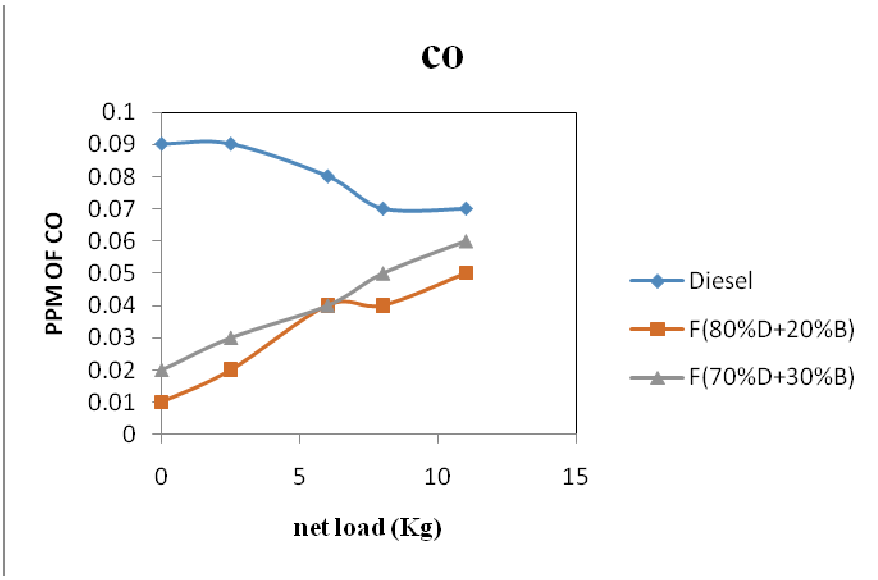

Figure 13: Load Vs CO Emission Graph.

CO emission of diesel is high when compared to all samples

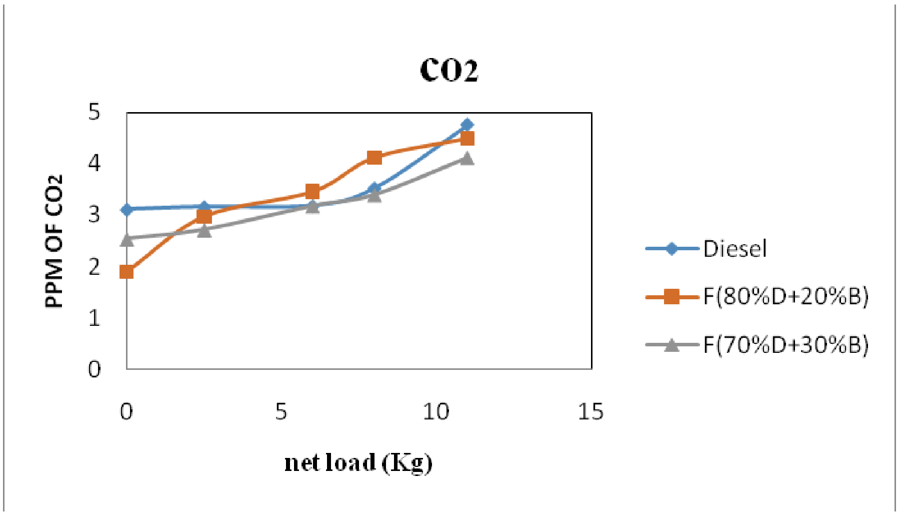

Figure 14: Load Vs CO2 Emission Graph.

The emission of CO2 in all samples are decreased compare to diesel. As shown in figure 6.9.

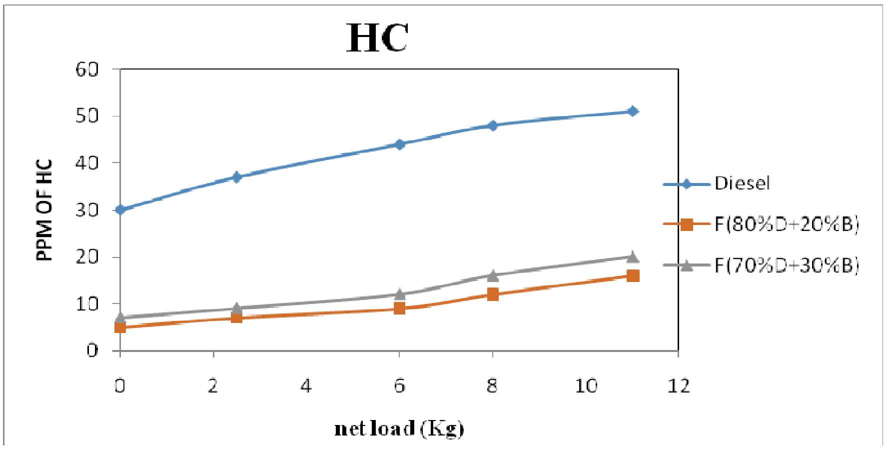

Figure 15: Load Vs HC Emission Graph.

The emissions of hydrocarbons are decreasing efficiently and satisfactory to reduce the air pollution and the engine exhaust as shown in figure 15.

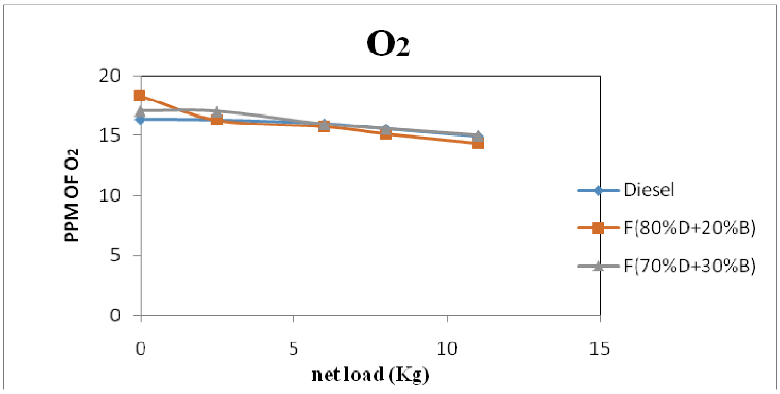

Figure 16: Load Vs O2 Emission Graph.

All samples results were proved with the increase in O_2 emission, Overall, betterment in emission features of engine when related with diesel.

CONCLUSIONS

In this paper performance, emission and combustion features of a engine with alcohol (butanol) fuel has been experimentally investigated. The butanol has blend with diesel in two sample 1. (80%D + 20%B) and 2. (70% D+30%B) proportion manually.

The smoke emission of diesel engine reduced drastically for all samples related to main diesel at all loads. Emission of CO, HC, and HC was lower than the diesel, according to the analyzation and expected results are obtained.

Emission characteristics of prepared samples when compared with diesel prepared samples shows reduction in emissions with increased efficiency.

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